CLAIMS

1. A system for recognizing wheels by artificial vision comprising:

wheel locating means;

first image capturing means;

first lighting means;

first control means comprising:

first communicating means for communications between the first control means and the first image capturing means;

second communicating means for communications between the first control means and the first lighting means;

wherein:

the first image capturing means and the first lighting means are arranged above the wheel locating means so as to enable the first image capturing means to capture a front image of a wheel to obtain a captured front image;

the first communicating means sends said front image to the first control means;

the first control means processes said front image to obtain data for identifying a wheel model.

2. A system according to claim **1** wherein the first control means further comprises:

first filtering means for filtering a captured front image to obtain a first filtered front image;

first transforming means for converting a circular portion of the first filtered front image into a rectangular portion to obtain a transformed front image;

second filtering means for filtering a transformed front image to obtain a second filtered image;

recognizing means for receiving an identification of a recognized wheel.

3. A system according to claim **1** further comprising:

second image capturing means;

second lighting means;

third communicating means for communications between the first control means and the second image capturing means;

fourth communicating means for communications between the first control means and the second lighting means;

wherein:

the second image capturing means and the second lighting means are arranged on a side of the wheel locating means so as to enable the second image capturing means to capture a side image of a wheel to obtain a side captured image;

the third communicating means sends said side image to the first control means;

the first control means processes said side image to obtain data for identifying a wheel model.

4. A system according to claim **1** further comprising:

third image capturing means;

fifth communicating means for communications between the first control means and the third image capturing means;

second transforming means for converting a circular portion of the central image into a rectangular portion to obtain a transformed central image;

wherein:

the third image capturing means are arranged above the wheel locating means so as to enable the third image capturing means to capture a central image of a wheel to obtain a central captured image;

the fifth communicating means sends said side image to the first control means;

the first control means processes said side image to obtain data for identifying a wheel model.

5. A system according to claim **1** further comprising:

second image capturing means;

second lighting means;

third communicating means for communications between the first control means and the second image capturing means;

fourth communicating means for communications between the first control means and the second lighting means;

third image capturing means;

fifth communicating means for communications between the first control means and the third image capturing means;

second transforming means for converting a circular portion of the central image into a rectangular portion to obtain a transformed central image;

wherein:

the second image capturing means and the second lighting means are arranged on a side of the wheel locating means so as to enable the second image capturing means to capture a side image of a wheel to obtain a side captured image;

the third communicating means sends said side image to the first control means;

the first control means processes said side image to obtain data for identifying a wheel model;

the third image capturing means are arranged above the wheel locating means so as to enable the third image capturing means to capture a central image of a wheel to obtain a central captured image;

the fifth communicating means sends said side image to the first control means;

the first control means processes said side image to obtain data for identifying a wheel model.

6. A system according to claim **1** further comprising second control means external to the first control means, wherein the first control means further comprises sixth communicating means for communications between the first control means and the second control means.

7. A system according to claim **1** further comprising:

second image capturing means;

second lighting means;

third communicating means for communications between the first control means and the second image capturing means;

fourth communicating means for communications between the first control means and the second lighting means;

second control means external to the first control means;

wherein:

the second image capturing means and the second lighting means are arranged on a side of the wheel locating means so as to enable the second image capturing means to capture a side image of a wheel to obtain a side captured image;

the third communicating means sends said side image to the first control means;

the first control means processes said side image to obtain data for identifying a wheel model;

the first control means further comprises sixth communicating means for communications between the first control means and the second control means.

8. A system according to claim **1** further comprising:

second image capturing means;

second lighting means;

third communicating means for communications between the first control means and the second image capturing means;

fourth communicating means for communications between the first control means and the second lighting means;

third image capturing means;

fifth communicating means for communications between the first control means and the third image capturing means;

second transforming means for converting a circular portion of the central image into a rectangular portion to obtain a transformed central image;

second control means external to the first control means;

wherein:

the second image capturing means and the second lighting means are arranged on a side of the wheel locating means so as to enable the second image capturing means to capture a side image of a wheel to obtain a side captured image;

the third communicating means sends said side image to the first control means;

the first control means processes said side image to obtain data for identifying a wheel model;

the third image capturing means are arranged above the wheel locating means so as to enable the third image capturing means to capture a central image of a wheel to obtain a central captured image;

the fifth communicating means sends said side image to the first control means;

the first control means processes said side image to obtain data for identifying a wheel model;

the first control means further comprises sixth communicating means for communications between the first control means and the second control means.

9. A system according to claim **1** further comprising:

second image capturing means;

second lighting means;

third communicating means for communications between the first control means and the second image capturing means;

fourth communicating means for communications between the first control means and the second lighting means;

third image capturing means;

fifth communicating means for communications between the first control means and the third image capturing means;

second transforming means for converting a circular portion of the central image into a rectangular portion to obtain a transformed central image;

second control means external to the first control means;

wherein:

the second image capturing means and the second lighting means are arranged on a side of

the wheel locating means so as to enable the second image capturing means to capture a side image of a wheel to obtain a side captured image;

the third communicating means sends said side image to the first control means;

the first control means processes said side image to obtain data for identifying a wheel model;

the third image capturing means are arranged above the wheel locating means so as to enable the third image capturing means to capture a central image of a wheel to obtain a central captured image;

the fifth communicating means sends said side image to the first control means;

the first control means processes said side image to obtain data for identifying a wheel model.

the first control means further comprises sixth communicating means for communications between the first control means and the second control means.

10. A system according to claim **6** wherein the second control means further comprises at least one controller selected from:

a production machine controller;

an assembly machine controller;

a production line controller;

an assembly line controller;

and combinations thereof.

11. A system according to claim **7** wherein the second control means further comprises at least one controller selected from:

a production machine controller;

an assembly machine controller;

a production line controller;

an assembly line controller;

and combinations thereof.

12. A system according to claim **8** wherein the second control means further comprises at least one controller selected from:

a production machine controller;

an assembly machine controller;

a production line controller;

an assembly line controller;

and combinations thereof.

13. A system according to claim **9** wherein the second control means further comprises at least one controller selected from:

a production machine controller;

an assembly machine controller;

a production line controller;

an assembly line controller;

and combinations thereof.

14. A system according to claim **10** wherein the first control means further comprises calibrating means to set standard wheel models which the wheel to be recognized are compared to.

15. A system according to claim **10** wherein the first control means further comprises storing means for storing standard wheel models which the wheel to be recognized are compared to.

16. A system according to claim **10** wherein the first control means further comprises

calibrating means to set standard wheel models;

storing means for storing standard wheel models;

which the wheel to be recognized are compared to.

17. A process for recognizing wheels by artificial vision wherein a system as defined in claim **1** is used, the process comprising a step for converting a circular portion of an image into a rectangular image by a polar transformation.

18. A process according to claim **17** comprising the following steps:

capturing a front image of a wheel situated on locating means lit by first lighting means, by first image capturing means, to obtain a captured front image;

applying a first filtering stage on the captured front image, by first filtering means, to obtain a first filtered front image;

converting a circular portion of the first filtered front image into a rectangular front image through a polar transformation by first transforming means to obtain a transformed front image;

measuring the wheel and determining material to obtain wheel dimensions and wheel material;

applying a second filtering stage on the transformed front image, by second filtering means, to obtain a second filtered image;

analyzing the second filtered image by comparing with pre-set standard wheel models stored in storing means for matching a wheel model to obtain a recognized wheel;

sending an identification of the recognized wheel to recognizing means;

returning to initial stage for receiving a next wheel to be recognized.

19. A process according to claim **17** comprising the following steps:

capturing a front image of a wheel situated on locating means lit by first lighting means, by first image capturing means, to obtain a captured front image;

applying a first filtering stage on the captured front image, by first filtering means, to obtain a first filtered front image;

capturing a side image of a wheel situated on locating means lit by second lighting means, by second image capturing means, to obtain a captured side image;

converting a circular portion of the first filtered front image into a rectangular front image through a polar transformation by first transforming means to obtain a transformed front image;

measuring the wheel and determining material to obtain wheel dimensions and wheel material;

applying a second filtering stage on the transformed front image, by second filtering

means, to obtain a second filtered image;

analyzing the second filtered image by comparing with pre-set standard wheel models stored in storing means for matching a wheel model to obtain a recognized wheel;

sending an identification of the recognized wheel to recognizing means;

returning to initial stage for receiving a next wheel to be recognized.

20. A process according to claim **17** comprising the following steps:

capturing a front image of a wheel situated on locating means lit by first lighting means, by first image capturing means, to obtain a captured front image;

applying a first filtering stage on the captured front image, by first filtering means, to obtain a first filtered front image;

capturing a central image of a wheel situated on locating means lit by first lighting means, by third image capturing means, to obtain a captured central image;

converting a circular portion of the first filtered front image into a rectangular front image through a polar transformation by first transforming means to obtain a transformed front image;

converting a circular portion of the central image into a rectangular central image through a polar transformation by the second transforming means to obtain a transformed central image;

measuring the wheel and determining material to obtain wheel dimensions and wheel material;

applying a second filtering stage on the transformed front image and on the transformed central image, by second filtering means, to obtain a second filtered image;

analyzing the second filtered image by comparing with pre-set standard wheel models stored in storing means for matching a wheel model to obtain a recognized wheel;

sending an identification of the recognized wheel to recognizing means;

returning to initial stage for receiving a next wheel to be recognized.

21. A process according to claim **17** comprising the following steps:

capturing a front image of a wheel situated on locating means lit by first lighting means, by first image capturing means, to obtain a captured front image;

applying a first filtering stage on the captured front image, by first filtering means, to obtain a first filtered front image;

capturing a side image of a wheel situated on locating means lit by second lighting means, by second image capturing means, to obtain a captured side image;

capturing a central image of a wheel situated on locating means lit by first lighting means, by third image capturing means, to obtain a captured central image;

converting a circular portion of the first filtered front image into a rectangular front image through a polar transformation by first transforming means to obtain a transformed front image;

converting a circular portion of the central image into a rectangular central image through a polar transformation by the second transforming means to obtain a transformed central image;

measuring the wheel and determining material to obtain wheel dimensions and wheel material;

applying a second filtering stage on the transformed front image and on the transformed central image, by second filtering means, to obtain a second filtered image;

analyzing the second filtered front image by comparing with pre-set standard wheel models stored in storing means for matching a wheel model to obtain a recognized wheel;

sending an identification of the recognized wheel to recognizing means;

returning to initial stage for receiving a next wheel to be recognized.

22. A process according to claim **18** wherein the recognized wheel takes a value selected between:

valid wheel when the second filtered image and the pre-set standard wheel model are matched;

defective wheel when the second filtered image and the pre-set standard wheel model are not matched.

23. A process according to claim **18** for enabling a user to set which portions of a captured image are visible wherein the first filtering stage comprises:

dividing the captured image into 360°/α sectors, α being the degrees per sector;

selecting the sectors showing a complete surface of the captured image to obtain a plurality of selected sectors;

preparing the selected sectors to adequate black and white/color tone levels.

24. A process according to claim **22** for enabling a user to set which portions of a captured image are visible wherein the first filtering stage comprises:

dividing the captured image into 360°/α sectors, α being the degrees per sector;

selecting the sectors showing a complete surface of the captured image to obtain a plurality of selected sectors;

preparing the selected sectors to adequate black and white/color tone levels.

25. A process according to claim **23** wherein α is 45°.

26. A process according to claim **24** wherein α is 45°.

27. A process according to claim **18** wherein the second filtering stage comprises applying a plurality of filters for enhancing transformed image parameters selected from at least one of quality, contrast, framing, focusing and combinations thereof.

28. A process according to claim **24** wherein the second filtering stage comprises applying a plurality of filters for enhancing transformed image parameters selected from at least one of quality, contrast, framing, focusing and combinations thereof.

29. A process according to claim **22** wherein the second filtering stage comprises applying a plurality of filters for enhancing transformed image parameters selected from at least one of quality, contrast, framing, focusing and combinations thereof.

30. A process according to claim **23** wherein the second filtering stage comprises applying a plurality of filters for enhancing transformed image parameters selected from at least one of quality, contrast, framing, focusing and combinations thereof.

31. A process according to claim **18** further comprising a first calibrating stage for calibrating a center of a standard wheel model comprising:

locating a standard wheel model;

framing the image to center the standard wheel model;

altering lighting of the first lighting means and focus of the first image capturing means to obtain a clear and sharp front image.

32. A process according to claim **24** further comprising a first calibrating stage for calibrating a center of a standard wheel model comprising:

locating a standard wheel model;

framing the image to center the standard wheel model;

altering lighting of the first lighting means and focus of the first image capturing means to obtain a clear and sharp front image.

33. A process according to claim **28** further comprising a first calibrating stage for calibrating a center of a standard wheel model comprising:

locating a standard wheel model;

framing the image to center the standard wheel model;

altering lighting of the first lighting means and focus of the first image capturing means to obtain a clear and sharp front image.

34. A process according to claim **22** further comprising a first calibrating stage for calibrating a center of a standard wheel model comprising:

locating a standard wheel model;

framing the image to center the standard wheel model;

altering lighting of the first lighting means and focus of the first image capturing means to obtain a clear and sharp front image.

35. A process according to claim **23** further comprising a first calibrating stage for calibrating a center of a standard wheel model comprising:

locating a standard wheel model;

framing the image to center the standard wheel model;

altering lighting of the first lighting means and focus of the first image capturing means to obtain a clear and sharp front image.

36. A process according to claim **27** further comprising a first calibrating stage for calibrating a center of a standard wheel model comprising:

locating a standard wheel model;

framing the image to center the standard wheel model;

altering lighting of the first lighting means and focus of the first image capturing means to obtain a clear and sharp front image.

37. A process according to claim **17** further comprising a second calibrating stage for calibrating dimensions of a standard wheel model comprising:

pointing to minimum radius and maximum radius of the standard wheel model;

zooming to an image defined by said minimum radius point and maximum radius point;

introducing a standard wheel model diameter.

38. A process according to claim **24** further comprising a second calibrating stage for calibrating dimensions of a standard wheel model comprising:

pointing to minimum radius and maximum radius of the standard wheel model;

zooming to an image defined by said minimum radius point and maximum radius point;

introducing a standard wheel model diameter.

39. A process according to claim **28** further comprising a second calibrating stage for calibrating dimensions of a standard wheel model comprising:

pointing to minimum radius and maximum radius of the standard wheel model;

zooming to an image defined by said minimum radius point and maximum radius point;

introducing a standard wheel model diameter.

40. A process according to claim **31** further comprising a second calibrating stage for calibrating dimensions of a standard wheel model comprising:

pointing to minimum radius and maximum radius of the standard wheel model;

zooming to an image defined by said minimum radius point and maximum radius point;

introducing a standard wheel model diameter.

41. A process according to claim **22** further comprising a second calibrating stage for calibrating dimensions of a standard wheel model comprising:

pointing to minimum radius and maximum radius of the standard wheel model;

zooming to an image defined by said minimum radius point and maximum radius point;

introducing a standard wheel model diameter.

42. A process according to claim **23** further comprising a second calibrating stage for calibrating dimensions of a standard wheel model comprising:

pointing to minimum radius and maximum radius of the standard wheel model;

zooming to an image defined by said minimum radius point and maximum radius point;

introducing a standard wheel model diameter.

43. A process according to claim **27** further comprising a second calibrating stage for calibrating dimensions of a standard wheel model comprising:

pointing to minimum radius and maximum radius of the standard wheel model;

zooming to an image defined by said minimum radius point and maximum radius point;

introducing a standard wheel model diameter.

44. A process according to claim **31** further comprising a second calibrating stage for calibrating dimensions of a standard wheel model comprising:

pointing to minimum radius and maximum radius of the standard wheel model;

zooming to an image defined by said minimum radius point and maximum radius point;

introducing a standard wheel model diameter.